NATIONAL MUSEUM OF THE UNITED STATES AIR FORCE

MATHEMATICS OF FLIGHT: GLIDE SLOPE I

Students will have a basic understanding of math applications used in flight. This includes the glide slope. Students will solve a series of problems. (One in a series)

LESSON PLAN

Grade Level: 6-7

Common Core State Standards for Mathematics:

The Number System—Compute fluently with multi-digit numbers and find common factors and multiples . (Grade 6);
Expressions and Equations—Reason about and solve one-variable equations and inequalities. (Grade 6), Solve real-life and mathematical problems using numerical and algebraic expressions and equations. (Grade 7).

Lesson Objective

The students will:

- Be introduced to formulas used in flight related to navigation and aircraft performance.
- Learn to calculate the glide slope.

Goal

In this lesson, students will gain an understanding of common calculations performed by flight personnel.

Glide Slope

The rate at which an aircraft descends is referred to as the slope of descent. It is defined the same as the slope in graphing:

$$\text{Slope} = \frac{\text{Change in the vertical (y) axis}}{\text{Change in the horizontal (x) axis}} = \frac{\text{rise}}{\text{run}}$$

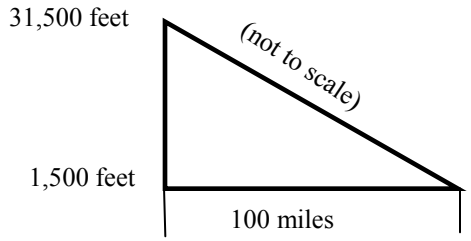
Since the aircraft is descending, rise refers to the amount of descent. The glide slope is often given as a percent.

Example:

Find the approximate slope of descent, expressed as a percent, if an aircraft is flying at 31,500 feet, headed for a landing site 100 miles away. The elevation of the landing site is 1,500 feet.

Solution:

$$\text{Slope} = \frac{\text{Change in the vertical (y) axis}}{\text{Change in the horizontal (x) axis}} = \frac{\text{rise}}{\text{run}}$$



Materials Required:

- Paper
- Writing utensil
- Formula:

$$\text{Slope} = \frac{\text{Change in the vertical (y) axis}}{\text{Change in the horizontal (x) axis}} = \frac{\text{rise}}{\text{run}}$$

Solution:
The aircraft will descend 31,500 ft. − 1,500 ft. = 30,000 feet over 100 miles.

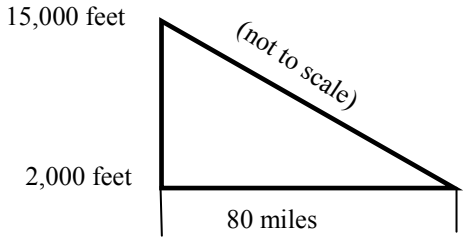
Ratios compare like units. To create the ratio of the slope, 100 miles must be converted to feet.

$$100 \text{ miles} \times \frac{5{,}280 \text{ ft./mile}}{1 \text{ mile}} = 528{,}000 \text{ feet}$$

The ratio of the slope is: $\frac{30{,}000 \text{ feet}}{528{,}000 \text{ feet}}$ or 0.0568 or 5.68%

Exercise 1:
Find the approximate slope of descent, expressed as a percent, if an aircraft is flying at 15,000 feet, planning to land 80 miles away. The elevation of the landing site is 2,000 feet.

Solution:
Using a diagram, we can determine the slope: $\text{slope} = \frac{\text{Change in the vertical (y) axis}}{\text{Change in the horizontal (x) axis}} = \frac{\text{rise}}{\text{run}}$



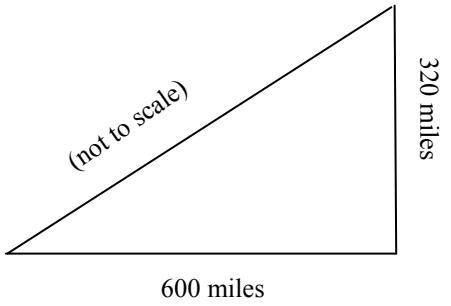
The aircraft will descend 15,000 feet − 2,000 feet = 13,000 feet over 80 miles.

To create the ratio of the slope, 80 miles must be converted to feet.

$$80 \text{ miles} \times \frac{5{,}280 \text{ ft/mile}}{1 \text{ mile}} = 422{,}400 \text{ feet}$$

The ratio of the slope is: $\frac{13{,}000 \text{ feet}}{422{,}400 \text{ feet}}$ or 0.03077 or 3.08% (rounded)

Exercise 2:
Find the approximate slope of ascent, expressed as a percent of launched space shuttle orbiter. When the space shuttle orbiter reached an altitude of 320 miles, it had covered 600 miles over the ocean.



Solution:
The aircraft will ascend 320 miles over 600 miles.

The ratio of the slope is: $\frac{320 \text{ miles}}{600 \text{ miles}}$ or 0.5333 or 53.33%

See student worksheet and presentation.

Resources:

National Museum of the United States Air Force

Belcher, Diana. *Education in Flight: A Teacher's Guide to the Mathematics of Flight.* Department of the Air Force, 2007.

NATIONAL MUSEUM OF THE UNITED STATES AIR FORCE

MATHEMATICS OF FLIGHT: GLIDE SLOPE

STUDENT WORKSHEET *NAME:*_____

Slope = $\frac{\text{Change in the vertical (y) axis}}{\text{Change in the horizontal (x) axis}} = \frac{\text{rise}}{\text{run}}$

Exercise 1:
Find the approximate slope of descent, expressed as a percent, if an aircraft is flying at 15,000 feet, planning to land 80 miles away. The elevation of the landing site is 2,000 feet.

Exercise 2:
Find the approximate slope of ascent, expressed as a percent, of a launched space shuttle orbiter. When the space shuttle orbiter reached an altitude of 320 miles, it had covered 600 miles over the ocean.